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ABSTRACT

A competency-based methods course for preservice secondary mathematics teachers is described. Ten competencies, or skills, are identified as necessary for the successful teaching of mathematics. Each student either tests out of or works through a series of modules associated with each skill or competency. The objectives may be either knowledge, performance or consequence levels. An example is given of a module containing all three levels.
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A Competency Based Methods Course For
Prospective Secondary Mathematics Teachers

By

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For the past several years, teacher trainers have wrestled with the persistent problem of how best to prepare teachers for our modern and changing society. It is felt that traditional teacher preparation programs are out-of-date and ineffective.

The University of Houston, has implemented a Competency Based Teacher Education program primarily at the elementary level. The Mathematics Education Area, however, has also implemented a program for the preparation of prospective secondary mathematics teachers, whose primary component is the use of modules in a field experience setting.

General Course Objective

To help mathematics teachers develop teaching strategies, competencies and skills with which they can meet the needs of individual students. This objective will be met through:

1. Seminar Activities:

Which will provide input at all levels of learning through handouts, films, self-instruction modules, group discussions and individual conferences, and provide feedback pertaining to the lab and field experiences.

2. Laboratory Activities:

A laboratory activity has the following properties:

1. organize learners into small groups,
2. is of a relatively short duration,
3. utilizes inquiry technique,
4. accepts group generated information for analysis,

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5. task oriented
6. attempts to alter the learner's behavior through his recognition of the related universe of alternatives.

3. Field Activities:

Which will provide the students with opportunities to evaluate the use of teaching aids and skills in actual classroom situations; and to observe and experience the role of the mathematics teacher in the teaching profession.

The complete undergraduate program in Mathematics Education consists of three phases, Phase I, Phase II, and Phase III, each phase consisting of a six semester hour bloc. Phase I is concerned with the development of generic competencies, while Phase II consists of some generic competencies along with specific competencies (Methods of Teaching Secondary School Mathematics). Phase III is the internship or student teaching experience.

We are concerned here with part of Phase II, which, as noted above, consists of three semester hours of generic competencies along with three semester hours of specific competencies i.e., the methods course. It is the methods course which will be described here.

In mathematics education, each prospective teacher is assigned to a school for field experiences at the beginning of Phase I. Unlike other content areas, each prospective mathematics teacher is introduced by the author to the school principal, to the department chairperson, and to the cooperating teacher. The pre-teacher may remain in this one school for all three phases, or he/she may be transferred to another school at his/her request at the end of the semester. Each

must spend a minimum of thirty clock hours in field experiences in Phase I and Phase II.

This methods course, designated SED 432, presently consists of ten* competencies and skills which were considered to be prerequisites for successful teaching of mathematics. The modules designed to enable the pre-teachers to demonstrate these skills and competencies, were field tested and revised for five semesters before they were fully implemented in the Fall semester of 1973.

Much of the student's time in SED 432 is devoted to field experiences, although the first three or four class meetings of each semester are held on campus for orientation to the modules, learning to use Video tape recorders and other audio-visuals, and working on knowledge-level objectives (more about this later). After the students go into the field, seminars are scheduled on campus periodically as necessary or at the request of the prospective teachers.

In order to demonstrate the defined skills and competencies, each pre-teacher either tests out of or works through a series of modules associated with each skill or competency. The objective(s) of each module may be either knowledge level, performance level, or consequence level. Thus, some skills and competencies may require all three levels, or just the knowledge and performance levels. There is also one exploratory level module which consists of some professional experiences such as attending local mathematics council meetings, faculty meetings, departmental meetings, and the like.

*These ten skills and competencies are: (1) Questioning Techniques, (2) Use of Teaching Materials, (3) Diagnostic Skills, (4) Use of Mathematics Games, (5) Use of Self-Instruction Modules, (6) Use of Inductive and Deductive Strategies, (7) Unit and Daily Lesson Planning, (8) Assessing Student Progress, (9) The use of Computer for Instruction, and (10) Teaching the Rational numbers.

Knowledge, performance, and consequence levels are defined below:

Definition of K, P, and C Modules

Knowledge, performance and consequence are terms applied to characterize the kind of behavior which is used to evaluate the learner in achieving the objective. The abbreviations used in this course for these terms are K, P, and C.

1. A K-Module could require demonstration of a simple type of memorization, such as knowing the set of parts of a lesson plan. It could also require the learner to apply, synthesize, or analyze knowledge. Explaining the reason for the use of a Table of Specifications in constructing a valid Evaluative Instrument would be an example of the analysis of knowledge. A knowledge-oriented objective is measured by an oral or written test.
2. A P-Module requires the learner to apply his knowledge in constructing a product of some kind, i.e. a test, a lesson plan, some questions, a self-instruction module. An evaluation of the product would determine whether the learner had achieved the objective.
3. A C-Module involves the learner in the use of the product with students in some educational situation. The effectiveness of the product, in achieving its purpose with the students, be it a test to measure achievement, a self-instruction module to teach a specific concept, or a lesson plan to use a strategy for teaching, will be the criterion for attaining the objective.

A module, as defined by the author, consists of:

- 1) Rationale
- 2) Objective(s)
- 3) Pre-Test (Primarily for K-level objective)
- 4) Enabling activities (these may refer to certain materials, either printed or media)
- 5) Evaluation

The enabling activities serve as options for the student, i.e., the student may do each activity, some of them, or none of them. One activity is always listed as "student option." Students may take the pre-test on most K-level modules and opt out of it if they achieve the objective. However, it is very difficult, if not impossible, to opt out of a P or C level module.

Usually, individualizing also allows the learner to move through a set of activities at a pace which he sets. Obviously, this means that there must be materials and activities organized so that students can work independently. It also implies that these activities be sequenced so the learner acquires the ability to perform as stated in the objectives. This type of instruction represents the thinking of Gagne.

In order to illustrate modules, the author has included a series of modules which exemplify all three levels of objectives. The competency is Diagnostic Skills, which is directly related to "Use of Mathematical Games," and "Use of Self-Instruction Modules," since each of these competencies is derived from the interpretation of the results of diagnosis.

DIAGNOSTIC PROCEDURES (Modules)

Rationale

The trend to competency-based curriculum using Individually Prescribed Instruction is shifting the emphasis of the role of the teacher from a purveyor of information to that of diagnostician and prescriber. As a mathematics teacher, you will be faced with the problem of determining how much and what kinds of knowledge students bring to a particular learning situation. You need to decide whether the student is "ready" for a particular concept or whether he is lacking some of the prerequisites needed for success.

With the increased emphasis on individualization, diagnostic tests are being developed to accompany many of the textbook series. To utilize them effectively, teachers should realize the strengths and limitations of such tests. Since these tests are supplementary and add to the cost of materials, many school districts may not furnish them. For these and other reasons the teacher must be able to construct such tests for the students.

The objective tests will not furnish all the information about a child which is helpful in instructing him. There is a need for relatively subjective evaluation techniques which are used to record observations of behavior in the affective domain. Anecdotal records, rating scales, checklists, etc., help teachers get a truer picture of the ability and potential of the individual.

This module is intended to help the learner recognize the importance of an effective diagnostic program. It should also provide you with experience in constructing, administering, and interpreting a diagnostic instrument both in the affective and cognitive domains.

Module IV-K

Objective

Given a sample diagnostic test, the student will be able to evaluate it with 90% accuracy.

Enabling Activities

1. Read, Norman E. Gronlund, Measurement and Evaluation in Teaching. 3rd Ed., pp. 17, 137, 807-10, 494-500. (LRC Satellite and Main Library)
2. Read handout, "The Diagnostic Test," to be obtained from instructor.
3. Examine samples of teacher-made diagnostic tests on file in LRC.
4. Read, Fredericka K. Reisman, "How to Prepare an Informal Mathematics Inventory," from A Guide to the Diagnostic Teaching of Arithmetic, pp. 31-34. (LRC Satellite)
5. Read, "Classroom Diagnosis," (LRC Satellite)
6. Attend seminar on "The Construction and Use of the Diagnostic Test" (schedule with instructor)
7. Listen to audio-tape on "Methods of Diagnosis." (LRC Satellite)
8. Study and Use, "Analysis of Diagnostic Test" (obtain from instructor).
9. Student option

Evaluation

Given a sample diagnostic test, the student will submit a written evaluation, using criteria developed by the student.

Module IV-P

Objectives

Given from one to three secondary school students, and a mathematics concept, the learner will be able to construct a valid diagnostic test.

Enabling Activities

1. The learner will review the evaluation criteria studies in Module IV-K.
2. The learner will work with from one to three high school students in his field experiences, and after discussions with the cooperating teacher, will construct a diagnostic test to ascertain the learning strengths and weaknesses of the students.
3. The learner will examine the permanent records of the high school students and note pertinent data which may affect their learning.
4. Student option.

Evaluation

The learner will submit the diagnostic test to the instructor who will evaluate the test according to criteria established in Module IV-K.

Module IV-C

Objective

Given an approved diagnostic test for a mathematics concept and from one to three secondary school students, the learner will determine whether or not the students have a learning difficulty with 90% accuracy.

Enabling Activity

Using the test constructed in IV-P, administer the test to from one to three students, and interpret the results.

Evaluation

The learner will write a diagnosis of the readiness of the student(s) for the concept diagnosed. This diagnosis will take into account the data obtained from the permanent records of the student(s). The learner will submit this written document to the instructor.

As the reader can see from examining the enabling activities, there are quite a few materials associated with this one module. Other modules likewise require a number of materials. SED 432 relies heavily on video-tape, audio-tape, slide projectors, and other media. All these are located in the Learning Resources Center (LRC) which occupies the entire third floor of the Education Building. All the modules are stored here and numbered and color-coded as to level and area.

All printed material is kept in the LRC Satellite, located on the second floor. Additionally, quite a number of the printed handouts are kept in the office of the author, along with mathematics and mathematics methods texts. A mathematics laboratory on the second floor contains a variety of teaching aids, concrete learning materials, and the like.

As a further aid to the student, the module book contains eleven pages of resources needed in all the modules, i.e., the name of the resource, where each resource is located, etc.

Evaluation

A. Evaluation of Modules

The behavioral objective determines the method of evaluation. Most K-level modules can be evaluated by paper and pencil type instruments or orally. Some are self-evaluated by the student or a group of students.

Evaluation of P-level modules is more complicated, for since the student is involved in producing something or doing something such as micro-teaching, observation instruments such as checklists, and rating scales are used. For example, Module VII-P, teaching a micro-lesson using inductive and deductive teaching strategies, is evaluated via a checklist and critique of the lesson from a video-tape which has been made of the student involved in this activity. Both student and instructor participate in the critique.

Evaluation of the consequence or C-level module is rather straightforward. Was whatever the prospective teacher did with the students successful? For example, did the self-instruction module, constructed by the pre-teacher enable the student or students to achieve the objective? If the objective was achieved, then the performance criterion is satisfied. Since the staff cannot always be present at these events, the cooperating teacher and the pre-teacher write a short summary of the event, noting the attitudes of the student(s) along with the degree of success of the students.

The Exploratory level is open-ended and is not evaluated as such. At the end of the semester the student submits a summary of all professional meetings, faculty meetings, and schools he has attended during the semester.

B. Evaluation of the Course

Philosophically, a Competency Based Teacher Education evaluation design has to answer the question, "Were the objectives achieved at the level of competence stipulated?" If the answer is yes, then the grade should be either A, or Pass, or Satisfactory. If the answer is no, then the grade should be either F, Fail or Unsatisfactory, depending upon the system used.

Most colleges, however, use the A, B, C, D, F, or I method of reporting student progress, as does the University of Houston. Therefore, the evaluation in this course has to conform to this system.

The staff of the mathematics education area has given a great deal of thought to this matter of evaluation and have designed the following format:

1. For having satisfactorily completed all K, P, and C level modules, a grade of A will be assigned.
2. For having satisfactorily completed all K, P, and at least two C level modules including VIII-C, a grade of B will be assigned.

3. For having satisfactorily completed all K level and at least eight P level modules, including module VIII-P and VII-P a grade of C will be assigned.

It is understood that any student may opt out of a K level module by satisfactorily completing the Pre-test or by convincing the instructor that he has attained these skills or competencies.

After having completed SED 432, the student will enroll in student teaching, a six semester hour block known at the University of Houston as Phase III, or Internship. Rather than being the initial and terminating field experience, Phase III is considered to be merely an extension of previous field experiences. Adjustment to the Internship program is very easy for the prospective mathematics teacher since he usually continues in the same school with the same cooperating teacher with whom he was placed in SED 432.

CONTINUOUS FEEDBACK

One of the advantages of the CBTE Secondary Mathematics Program is that it enables the staff to receive continuous feedback and as a result, can be modified to a changing society. For example, the present SED 432 course, has, with some revision, been operative since the Fall of 1973. On the basis of feedback from students, who have taken the course, cooperating teachers, and mathematics supervisors, the author is in the process of revising the module book.

One may readily see that you never really finish a CBTE program since both modules and program are constantly being revised on the basis of the continuous feedback process.

DOES CBTE PRODUCE BETTER TEACHERS?

The jury is still out on this question, for to the knowledge of the author, there has been very little published research regarding its merits. The concept is too new, and not many programs are now operational. Some preliminary studies have been reported, however.

One such program, the NUSTEP at the University of Nebraska, has published some results of several studies. These studies indicate that the program had positive effects on attitudes of student teachers so far as teacher behaviors were concerned. This data also strongly suggests student preference for the theoretical portion of NUSTEP. (NUSTEP; 5-6)

Francke, a doctoral student at the University of Nebraska, reported a study which compared the achievement of secondary school students in English who were taught by an instructor who had participated in a CBTE program with those who were prepared in a traditional program. (Francke, 1971). The first group achieved a mean score of .739 on the research post test while students in the second group achieved a mean score of .680, a statistically significant difference favoring CBTE-prepared instructors. The author concluded that CBTE-trained teachers were more effective.

Feedback from teachers, principals and superintendents in the Houston area who employ our mathematics teachers indicates that the teachers who have participated in the CBTE mathematics education program are much better prepared to teach than teachers who have not been through such a program.

The author, too, "feels it in his bones", that through CBTE, mathematics teachers are being produced who are better equipped to handle the decision making, innovative teaching techniques, curriculum development, and evaluation associated with teaching. It is felt that this is particularly true because each teacher produced by the program has been through a

primarily individualized and humanized experience and has demonstrated those skills and competencies necessary for effective mathematics instruction to take place.

RESOURCES

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